ELEMENTS

OF

PHOTOGRAPHY.

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OPTICIANS, PHILOSOPHICAL, CHEMICAL, AND PHOTOGRAPHIC INSTRUMENT MAKERS TO HER MAJESTY THE QUEEN, AND THE GOVERNMENT DEPARTMENTS.

CONTENTS.

	PAGE.
Preface	5
Apparatus	7
The Dark Room	13
Glass Plates	14
Collodion	15
The Nitrate of Silver Bath	23
Developing Solutions	24
Fixing Solutions	27
Cleaning Glass Plates	28
Coating the Plate	31
Giving Sensibility to the Plate	33
Exposing the Plate	34
Developing the Picture	37
Fixing the Negative	39
Varnishing the Negative	41
Printing	42

PAGE.

Paper 42

Preparation of the Paper 42

Exposing the Picture 47

Toning the Print 48

Fixing the Print 50

Mounting the Print 51

Table of Weights and Measures 53

PREFACE.

In the following pages it is not my intention to bring forward anything strictly new. Having been engaged in the practice of Photography since the time that Talbot read his first paper and astonished people with the production of a copy of a piece of lace, and having experimented on every process, not so much with a view to obtain a large collection of pictures, as to ascertain the means by which the best pictures may be produced, I am induced to hope, that while the results of my experience may be of use to the beginner, they will not be altogether without interest to the more advanced follower of the Art.

APPARATUS.

Under this head little more can be done than to give a list of the necessary apparatus. The particular form of each article must depend so much on the precise purpose for which it is to be used, and on the taste of the operator, that but little advice can be given.

1. THE CAMERA.—Whatever form of camera is selected, one or two points should be carefully examined. 1st.—That the ground glass, and the prepared plate, when placed in the camera, are at precisely the same distance from the lens. 2nd.—That no light can penetrate any part of the camera. 3rd.—That every part is quite firm and without shake. For landscape-work, a double swing

back, to enable fore-ground and distance to be focussed, is very useful.

2. Lenses. — For ordinary landscapes, nothing is so good as a single lens. For buildings, more especially when it is necessary to work very close to them, and for copying, either the orthographic or the triplet lens is useful. For portraits, the double lens with central stops is to be preferred.

3. The Camera Stand.—The great requisite in the camera stand is that it should be perfectly firm and able to stand a moderate amount of wind without shaking. It should be so made that the camera can be placed in any required position.

4. The Focussing Cloth. — Any black material which completely excludes the light may be used for this purpose. Black velvet is very good. Water-proof fabrics should be avoided as they are very hot and stifling.

5. The Bath should be made of glass, and be somewhat larger than the plates employed. If intended for use in the field, it should be fitted in a padded case, and provided with a glass top ground quite flat, and

secured in its place by clamps, so that it can be carried full without danger.

6. The Dipper may be of glass, pure gutta percha, or silver wire. It should be $1\frac{1}{2}$ inches longer than the bath, and be turned up at the bottom to receive the glass plate. Dippers of ebonite are now much employed, and seem to answer very well.

7. The Pneumatic Holder is a contrivance for holding the glass plate while giving the final polish and coating with collodion. It is much on the principle of a boy's sucker, and prevents unnecessary handling of the plate.

8. The Buff.—A round piece of wood about 4 inches in diameter, with a knob on the back to hold it by, covered with velveteen secured in its place by a ring of brass or gutta percha after the manner of a drum head, is the best thing for giving the final polish to the plate.

9. The Brush.—A camel's hair brush is used to remove the last traces of dust from the plate before coating; those called gilder's tips are the cheapest, and answer very well.

10. The Collodion Pourer should be graduated, so that the collodion and iodizer can be measured in it. It should be provided with an external cap, which keeps any collodion adhering to the neck soft and unbroken, and avoids the spotting of the plate, so often produced by the fall of bits of dry collodion from a pourer with an internal stopper.

11. The Developing Holder.—A Pneumatic holder with a handle, and a shield to prevent the solution running over the hand, is very useful. Various other holders may be seen at the Photographic warehouses.

12. Developing Cups.—Cups for holding the developing solutions should be of glass or ebonite, smooth inside, and with round bottoms which can be easily cleaned. One should be kept for the iron solution, and another for pyrogallic acid. It is convenient to paint the foot of one of them with sealing wax varnish, that it may be easily recognized in the dark room.

13. Plate Boxes are grooved to receive either glass plates or negatives, and may be made of wood or metal. If required for the

purpose of holding fresh negatives while wet, the grooves should be V shaped, and made of gutta-percha, and the box should be provided with a vessel at the bottom to receive the drainings from the plates.

14. The Tent.—If the collodion process is to be worked in the field, a tent lighted by a yellow window in which all the operations can be carried on must be provided. They are made of various forms, and must be chosen by the operator. Whilst the picture is being exposed, and at all other convenient times, the front of the tent should be looped back and left as much open as possible to promote ventilation. If possible, the plate should be coated outside the tent, to avoid filling it with ether vapour.

15. The Pressure Frame should be strong, with a plate glass front, jointed back, and spring fastenings. A pad of felt or thick velvet should be put over the paper in the frame, and over this a sheet of thin card-board, the latter preventing the jointed back of the frame from creasing the felt or velvet.

16. Dishes are of various sizes and ma-

terials. They should be at least an inch larger each way than the largest plate used, and no dish should be used for more than one purpose. For silver solutions, a glass dish is the best; for toning, fixing, and washing, porcelain or gutta-percha may be used.

MISCELLANEOUS.

Stoppered bottles for holding solutions, glass funnels, graduated measures, glass stirring rods, scales and weights, horn tongs for removing paper from silver solutions, blotting paper, &c., &c., must be provided according to the requirements of the operator.

THE DARK ROOM.

The dark room is so called, because no light which can act on the prepared surface destined to receive the picture, is admitted into it. Artificial light, not too bright, or daylight which has passed through certain yellow media, is all that can be allowed. In a room, two thicknesses of the glass known as orange pot metal, are generally found effectual for use; in a tent, various kinds of yellow silk, calico, or tammy, are employed. They should be tested by exposing a sensitive collodion plate under them to the action of a bright light (direct sun light if possible) for some minutes, and subsequently developing it. Unless this can be done without causing fog on the plate, the material is not fit for use.

GLASS PLATES.

The glass plates employed in Photography are usually either of Patent Plate, or Flatted Crown Glass.

The former though dearer, is preferable, on account of its greater flatness and superior polish. Should crown be used, care should be taken to select only such pieces as are really flat (which can be ascertained by laying them one on the other), as if they be not so, the negatives are liable to break in the pressure frame. On passing the finger over the surface of crown glass, it will be found that one side is much smoother than the other, and this side only should be coated with collodion. Patent plate may be coated on either side.

COLLODION.

Collodion is a solution of pyroxyline (gun cotton) in a mixture of ether and alcohol, that kind employed in photography contains also an iodide which is soluble in ether and alcohol, or a mixture of an iodide and bromide, or of these two substances and a chloride, so that when the collodion is poured on a glass plate and immersed in a solution of nitrate of silver, iodide, or mixed iodide, bromide, and chloride of silver are found in the resulting film. The preparation of pyroxyline is too troublesome an operation to be undertaken by amateurs, indeed as a rule it is better for them to buy some one of the many good collodions which are prepared for sale, than to attempt to make it for themselves. Nevertheless a few words on its preparation may not be out of place.

A good collodion should contain from 5 to 8 grs. of pyroxyline to the oz. A pyroxyline, of which 6 grs. cannot be dissolved in one oz. of mixed alcohol and ether without making it too thick to flow readily, will not make a

really good collodion. The best proportions of ether and alcohol are, as a rule, equal quantities of each. Four drachms of ether and two of alcohol should be mixed, and the 6 grs. of pyroxyline added, to make the plain collodion; the requisite quantity of iodide &c. should be dissolved in the remaining 2 drs. of alcohol, and the collodion, after getting clear, added to them, to make the oz. of prepared collodion.

The nature and proportion of the iodides and bromides employed, should be regulated by the use to be made of the collodion. Where only black and white subjects, such as engravings, are to be copied, a simple iodide, or an iodide with a small quantity of a chloride to increase the intensity of the blacks, is all that is necessary. Bromide of silver, being more readily affected by light of various colors than iodide, and giving also much greater delicacy of half-tone, a bromide should always be employed in conjunction with an iodide, either for landscape or portrait collodion where the best possible results are desired. The qualities which it is most desirable to unite in order to form a perfect collodion, are the maximum of sensibility to

light, not only white but colored, and the power of bearing an exposure sufficiently long to bring out the detail in the deepest shadows, without becoming solarized in the lighter parts.

Much discussion has recently taken place, as to whether the presence of bromides increases the sensibility of collodion, and many contradictory assertions have been made on the subject. I believe these contradictions are mainly owing to the fact, that but few of the experimenters have paid any attention to the proportion of the bromide to the iodide, or of both to the quantity of pyroxyline in the collodion. To attain the maximum of sensibility, the collodion should contain, after being sensitized, as much silver (whether as iodide or bromide) as can be retained firmly by the film. If it contain less than this, the silver salts are so surrounded by pyroxyline, as to be comparatively insensible; if it contain more, the silver salts wash out into the bath, and leave streaks on the film. It is universally admitted that in the Daguerreotype process, bromide in conjunction with iodide of silver, is far more sensitive than iodide alone.

The reason of this universal admission I believe to be due to the fact, that a very slight difference in the proportions of iodide and bromide in this process, renders a plate not only less sensitive, but almost insensitive, so that Daguerreotypists were obliged to pay that strict attention to proportions, which the experimenters in collodion have many of them failed to do, and hence, I believe, has arisen the discrepancies in their opinions.

A careful consideration of the very slight difference of proportions which so completely altered the state of a Daguerreotype plate, convinced me that it could only be satisfactorily accounted for on the supposition that there is a real chemical compound of iodide and bromide of silver, which possesses in an eminent degree the two qualities of sensibility, and resistance to solarization. Many experiments led me to the same conclusion. In 1851 I made a long series of experiments to see if iodides and bromides mixed in the proportion of their chemical equivalents, would not give those two properties both to paper and collodion in a greater degree than if they were mixed at random; and I arrived

at the conclusion that in all cases a mixture of two equivalents of iodide to one equivalent of bromide, was far more sensitive than iodide alone, or any hap-hazard mixtures of the two. These experiments were repeated some years after, and the results exhibited at a meeting of the Blackheath Photographic Society. In all the collodion experiments, the quantities of iodides and bromides employed were so arranged, that 6 grs. of pyroxyline were mixed with either iodide or bromo-iodide of silver, equivalent to 4.2 grs. of silver, so that the experiments were strictly comparable. No subsequent experience has in the least modified my conclusions on this subject.

The nature of the base with which the iodine and bromine in collodion are combined, exerts a remarkable influence on the character of the sensitive film. Comparatively few bases can be employed, more especially where both iodides and bromides are required, as many iodides, and more bromides, are insoluble in alcohol and ether. The salts most available are those of ammonium, cadmium, lithium, magnesium, potassium, or zinc. Of these, potassium (the first employed) has now gone

almost out of use, as the iodide is but sparingly soluble in any but weak alcohol, and the bromide almost insoluble. The salts of cadmium possess the advantage of being very stable, so that collodion prepared with them may be kept ready iodized for an almost indefinite time without change, a great advantage to those who only work occasionally. The greatest sensibility appears to be obtained by the use of those salts whose chemical equivalents are the lowest, which in fact leave the silver salts in the state of greatest purity in the film. Thus the salts of lithium, magnesium, and ammonium, give the most sensitive collodions, 6.43 parts of lithium, 12.67 of magnesium, and 18 of ammonium, being respectively equivalent to 55.74 of cadmium, and 39 of potassium. A great advantage also possessed by the salts of lithium and magnesium, is that the compounds formed by them on immersion in the bath of nitrate of silver, are deliquescent, so that they tend to keep the film moist. On a hot day a plate prepared with a cadmium collodion, will in a given time be so dry as to render it almost impossible to pour the developing solution

over it, while one prepared with magnesium or lithium collodion will be quite moist, and allow the developer to flow over it without difficulty. The following are the formulæ for collodion and iodizers which I find most useful:—

COLLODION.

Pyroxyline	48 grs.
Ether	4 ozs.
Alcohol	2 ozs.

IODIZING SOLUTIONS.

No. 1.

Iodide of Ammonium ...	30 grs.
Bromide of Ammonium ...	10 grs.
Alcohol	2 ozs.

No. 2.

Iodide of Cadmium	38 grs.
Bromide of Cadmium ...	14 grs.
Alcohol	2 ozs.

No. 3.

Iodide of Magnesium ...	29 grs.
Bromide of Magnesium ...	9.5 grs.
Alcohol	2 ozs.

No. 4.

Iodide of Lithium	27.5 grs.
Bromide of Lithium	9. grs.
Alcohol	2 ozs.

No. 5.

Iodide of Ammonium	...	40 grs.
Chloride of Calcium ...	...	3 grs.
Alcohol	...	2 ozs.

The ether and alcohol employed for this purpose, should be pure and anhydrous. In mixing the collodion and iodizer, the former should always be poured into the latter, as alcohol is the real solvent of the iodides, and if their solution be poured into a large quantity of collodion, some of the salt is often precipitated by the excess of ether present.

It is better never to use collodion till it has been iodized at least 24 hours. When the cadmium iodizer is employed, it should be kept much longer, it goes on improving for many weeks. The iodizer No. 5, I employ principally where only black and white objects have to be copied, and where it is desirable to obtain great depth in the blacks, and purity in the whites, as in copying engravings, &c.

Should a thinner collodion be required, the quantity of iodides and bromides employed, must be decreased in the same proportion as the pyroxyline, or the whole may be thinned after iodizing, by the addition of a mixture

of equal parts of ether and alcohol. Should the collodion become too thick by use, it may be restored to its original consistence by the addition of the same mixture. In very hot weather it is sometimes well to increase the proportion of alcohol, and diminish that of ether, but as a rule the above proportions answer the best.

THE NITRATE OF SILVER BATH.

The bath is best prepared in the following manner.—Dissolve 2 ozs. of nitrate of silver in 6 ozs. of distilled water. To 5 ozs. of the above, add 1 drachm of the solution employed to iodize the collodion. Shake these well together, and add 12 ozs. of water and 2 ozs. of alcohol. This will cause a deposit of iodide and bromide of silver. Allow it to stand, shaking occasionally, for about 12 hours. Filter it, and finally add 1 oz. of the original solution of nitrate of silver which was separated for the purpose. Thus prepared, the bath should be just perceptibly acid. Should it be found that the pictures have any tendency to fog, one or two drops of nitric acid may be added to the bath. Acetate of soda and acetic

acid are sometimes added to give increased density to the pictures. My own experience is that all such additions are either useless or worse. When a simply iodized collodion is employed, they may do no harm, but with a bromo-iodized collodion they are decidedly detrimental. As a rule, not more than one kind of collodion should be used in the same bath, as the accumulation of the various nitrates of different bases, deteriorates it much more rapidly than where only one is employed. When a bath ceases to work well, it will generally be found more advantageous to make a new one, and precipitate the silver from the old one by the addition of hydrochloric acid, than to attempt any kind of doctoring. The chloride of silver so obtained may be sold to the silver refiners.

DEVELOPING SOLUTIONS.

These are of two kinds. The first are employed for the purpose of developing the picture in the true sense of the term, that is rendering it apparent on the plate after exposure in the camera. The second are used only to increase the intensity of pictures already

developed. The precise strength and composition of these solutions is subject to much variation according to circumstances, differences of temperature, &c. The following are the solutions I find most generally useful.

DEVELOPERS.

No. 1.

Protosulphate of Iron	160	grs.
Glacial Acetic Acid	6	drs.
Spirit of Wine	6	drs.
Distilled Water...	20	ozs.

No. 2.

Protosulphate of Iron	600	grs.
Tartaric Acid	200	grs.
Nitric Acid...	40	drops.
Distilled Water...	20	ozs.

No. 3.

Pyrogallic Acid	8	grs.
Glacial Acetic Acid	½	dr.
Spirit of Wine	½	oz.
Distilled Water...	5½	ozs.

INTENSIFIER.

Pyrogallic Acid	40	grs.
Citric Acid...	20	grs.
Distilled Water...	20	ozs.

No. 1 is the developer employed by Mr. Vernon Heath.

No. 2 is recommended by Mr. Busk, as giving great intensity when an object has been but faintly illuminated. He employed it to develope enlarged copies of microscopic objects obtained by gas light.

No. 3 may be employed both as a developer, and an intensifier after No. 1. As a rule, pictures developed with pyrogallic acid are denser and not quite so rich in half-tone as iron-developed negatives; they also generally require a somewhat longer exposure. I usually dilute this solution with an equal bulk of water to begin the development, and when all the details are well out, pour on the stronger solution till the picture acquires the desired intensity. It will be observed that the quantities both of pyrogallic and acetic acids are smaller than those usually recommended. These two bodies being antagonistic in their action, the one promoting and the other retarding development, I find it better to use a weaker developer with only just acetic acid enough to ensure clean plates, than to use a stronger developer and check its action by the

addition of a large amount of acetic acid, a practice very much like pulling off with one hand what you have put on with the other.

The above solutions are employed in the production of negatives only. For positive pictures, the following will be found useful.

No. 4.

Protosulphate of Iron	300 grs.
Spirit of Wine	1½ ozs.
Glacial Acetic Acid	2 drs.
Nitric Acid...	½ dr.
Distilled Water...	20 ozs.

No. 5.

Protosulphate of Iron	720 grs.
Nitric Acid...	2 drs.
Spirit of Wine	2 ozs.
Distilled Water...	20 ozs.

FIXING SOLUTIONS.

No. 1.

Cyanide of Potassium	200 grs.
Water	20 ozs.

No. 2.

Hyposulphite of Soda	16 ozs.
Water	20 ozs.

The cyanide of potassium solution is the more convenient of the two, as it clears the plate more rapidly, and is much more easily

washed out of the film. With negatives developed by pyrogallic acid, it is however liable to dissolve out a little of the finer half-tones if left on the plate at all too long. In a close room or tent its odour often produces headache, and if the solution be allowed to get into cuts or scratches in the fingers, it will often produce serious inflammation. None of these disadvantages attend the use of hyposulphite of soda, but the plates are far more difficult to wash perfectly clean. Plates fixed with cyanide of potassium are far more liable to crack after varnishing than those fixed with hyposulphite of soda.

Having thus briefly noticed the materials employed in the production of pictures on glass, I proceed to a description of the various operations.

1.—CLEANING GLASS PLATES.

Too much importance cannot be attached to this operation, as if plates be not scrupulously clean, the best materials, and most careful subsequent manipulation, are thrown away.

Both sides of the plate should be equally clean, as any dirt on the back of the plate is

in part at least left in the bath. Many baths are entirely spoiled by want of care on this point.

When plates are new, they may be cleaned with either of the following liquids.

Spirit of Wine	2 ozs.
Solution of Ammonia	2 drs.
Water	½ oz.
Tripoli Powder	1 oz.
OR,	
Old Collodion	1 oz.
Spirit of Wine	1 oz.
Iodine	2 grs.
Tripoli Powder	½ oz.

The tripoli should be finely levigated, and quite free from grit.

Lay the plate either on a cleaning frame or a sheet of paper. Pour on to it a small quantity of one of the above liquids, previously well shaken. Rub it briskly all over the plate with a pad of cotton wool. Rub off as much of the powder as possible with another pad of cotton. Do the same on the other side of the plate. Put on a pair of thread gloves, and taking up the plate with a clean cloth, remove all tripoli from it, taking special care that none is retained by the rough edges. Lay the plate either on another

and very clean frame, or on a perfectly clean cloth, and with another cloth polish it well, first on one side, and then on the other. Now breathe on the plate. If the breath spread quite evenly over the plate, and vanish rapidly and evenly from its surface, it is clean; if not, it must be still further polished with the cloths. The greatest care should be taken to allow the breath to pass completely from the plate before it is again rubbed, as if the cloth once touches the breath, it becomes moist, and is sure to smear the plate. Wipe the plate gently on both sides with a silk handkerchief to remove any fluff left by the cloths, place it on a pneumatic holder, and give the final polish to the side intended to be coated, with a buff covered either with fine wash leather, or (which is better) with the thickest velveteen. Brush the plate on both sides with a clean camel's hair brush, and store for use. Plates are best kept by putting them in pairs with their last polished surfaces together and a piece of paper between each pair, and packing them well up in paper.

The cloths for the above purpose should be washed first in a pretty strong solution of

soda and subsequently in many waters, to remove all traces of soap. The velveteen should be prepared in the same manner. When dry, they should never be touched with the ungloved hand, and should be kept as much as possible from dust. The face of the buff should be occasionally brushed with a perfectly clean clothes brush. When plates have been used, they should be first washed free from the old film in water, then soaked for a short time in diluted nitric acid (about one part of acid to twenty of water), washed well under a tap, dried, and then treated as described for new plates. The treatment with nitric acid is specially necessary for plates which have been used with an iron developer.

2.—COATING THE PLATE.

Place the plate on a pneumatic holder, and having ascertained that it is perfectly clean by breathing on it as described above, remove all trace of dust from its surface with a soft brush. Hold the plate in the right hand quite horizontal, and pour on to one end of it sufficient collodion to flow easily all over

the plate. Incline the plate very gently so as to make the collodion flow quite up to that edge of the plate near which it was first poured. Tilt the plate gently in the opposite direction, so as to make the collodion flow in a uniform wave to the opposite edge of the plate. Finally pour off the excess of collodion into the pourer from one corner of the plate. Gradually raise the plate to a nearly perpendicular position, with its corner resting in the mouth of the pourer. Sway the plate gently backwards and forwards to remove all ripple marks from the surface of the collodion, and bring it again into a horizontal position. When the film is set, loosen the plate from the pneumatic holder, and proceed to the third operation. Different collodions require to be allowed to set to very different extents. The knowledge of the precise moment when it is best to put the plate into the bath can only be obtained by practice. Thus far the operations may be conducted in ordinary daylight.*

* A beginner will find it better if possible to see an experienced operator coat a plate. It is an operation difficult to describe, but very easy to perform.

3.—GIVING SENSIBILITY TO THE PLATE.

All but yellow light being carefully excluded from the room, raise the dipper out of the bath. Take the plate by one corner, injuring the film as little as possible, rest it on the dipper, and immerse it with one gentle and steady movement in the bath. Suffer the plate to remain quite still for at least two minutes, then raise it gently but quickly out of the bath, and immediately return it. Repeat this till the solution flows evenly over the face of the plate. Allow it to remain in the bath for a short time longer, then lift it out and let it drain for a few seconds into the bath. Take the plate by the same corner as that used in placing it on the dipper, rest its lower edge on some blotting paper, and dry its back by pressing some folds of blotting paper against it. Place the plate face downwards in the slide of the camera, with the edge from which the solution has been drained at the lower part. Place two folds of clean blotting paper on the back of the plate, and close the door of the slide. The slide should

after this be always kept as much as possible in the same position which it will occupy in the camera, to prevent any liquid which may have drained to the lower part of the plate, returning over the film, which it would be sure to stain.

4.—EXPOSING THE PLATE.

It is in this operation that all the skill and judgment of the photographer are needed. Just those qualities which make the difference between an artist and a mere draughtsman, are required to make the difference between a photographic artist and a mere photographer. The choice of the best possible point of view, the best lighting, &c. &c., are things for which no instructions can be given. In one respect a photographer is always acting at a disadvantage, his best point of sight is simply the best on which he can place his camera, not always the best in itself; moreover he cannot leave out anything which he, or rather his camera, can see, so that a chimney or other unsightly object which an artist can quietly ignore, frequently renders an otherwise beautiful view impossible to the photographer. Much however may be

done by a selection of the best available point of sight, and much more by a careful study of the best possible lighting. As respects portraits, in a room constructed for the purpose, the lighting is managed by a proper arrangement of blinds. In an ordinary room the difficulties are much greater, and all that can be said is that the use of a white sheet or screen to reflect the light on to the side of the sitter farthest from the windows, to prevent too great a shadow, is useful, in other respects the operator must be left to make the best of the circumstances in which he is placed. As respects landscapes, all that can be done having selected the point of sight, is to study the landscape at different times of the day, and under various circumstances, and select those which produce the most pictorial effect. Only one general rule can be given, which is to avoid having the light, more particularly a bright sun, directly behind the camera, it invariably gives a flat and meaningless picture. With respect to focussing, in landscapes it is *generally* better to focus on the middle distance. The stop employed must vary with the nature of the subject, and the amount of light. With a bright light,

the smaller the stop, the sharper the picture; in a dull light, a better picture is often obtained by using a somewhat larger stop, as the increased brilliancy makes up for a little less perfect sharpness. Too great attention cannot be paid to having the camera perfectly level, especially in photographing buildings, otherwise the upright lines will be distorted. The subject having been focussed, and the cap placed on the lens, pull out the ground glass, put the slide in its place, cover the whole with a focussing cloth, pull up the shutter of the slide, and expose the plate by removing the cap of the lens. No directions can be given for the time of exposure, it is entirely a matter of judgment. After the first picture has been developed, it is generally easy to hit the time very exactly. As a rule it is much better to expose for too long than too short a time, as a very good picture may be obtained after too long an exposure, by proper management in developing, but no art can bring out those parts of a picture which have not been exposed long enough to leave any impression on the plate.

5.—DEVELOPING THE PICTURE.

Two developing cups should be provided, one to be kept exclusively for iron, the other for pyrogallic acid. The plate having been exposed for the requisite length of time, close the shutter, still under the focussing cloth, and remove the slide to the yellow room. Pour enough of the iron developer to cover the whole surface of the plate easily, into one of the cups, open the slide, and place the plate on a developing holder, taking care to keep the edge of the plate which has been downwards in the camera, lower than the other, to prevent any drainings returning over the plate. Now pour the developer on at the opposite edge of the plate, passing the cup briskly along its whole length, so as to send the developer in a uniform wave all across the plate, let it flow off at the lower edge, carrying with it all the drainings, turn the plate in a horizontal position, pour on a small quantity more of the developer, and keep the plate gently moving. As soon as all the details of the picture are visible, pour off the developer, and wash well in water. Any prolonged use of iron after the

picture is once visible, no matter how faintly, only tends to fog it. The plate being washed, pour on the intensifyer in the same manner as the developer, then add to a small portion of the solution a few drops of a solution of nitrate of silver, 30 grs. to 1 oz., pour it over the plate, and keep it gently moving till the picture has acquired the requisite intensity. Pour off the intensifyer, and wash the plate well in water. When pyrogallic acid development alone is employed, dilute developer No. 3 with an equal bulk of distilled water, and pour it on the plate as described for the iron solution. When the details are all visible, wash the plate, and pour on some of the solution of its full strength, with the addition of a few drops of solution of nitrate of silver 30 grs. to the oz.*

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* The practice of holding up the plate to look through it during the process of developing should be carefully avoided, as the developer is sure to run in streaks, and cause markings on the plate. With a little practice, the operator can watch the progress of development by simply placing a piece of white paper in such a position as to reflect light up through the plate. If it be desirable to examine more thoroughly, the plate should be well washed in water till its surface is quite evenly covered before turning it up to look through it.

6.—FIXING THE NEGATIVE.

This operation consists in removing the iodide and bromide of silver which have not been acted on by light. Pour all over the plate a little of the solution of cyanide of potassium, or hyposulphite of soda. The yellow silver salts will at once begin to disappear, and leave the picture clear and bright. The clearing should be complete in about eight or ten seconds. Wash the plate well, back and front, in water. The plate may now be examined in ordinary daylight. If, on looking through it, it seems lacking in intensity, it may again be taken into the dark room, and some more intensifyer poured over it, but it is always better, if possible, to intensify to the right extent before fixing. Wash the plate thoroughly in water, and set it up on some blotting paper to drain. It is difficult to describe to a beginner precisely, those qualities which constitute a good negative. He will learn more from an examination of a few whose printing qualities have proved them to be good, than from anything that can be said. One or two requisites may however be men-

tioned. The best printing negatives are generally of a deep London smoke color, without one bit of clear glass in any part, and nothing absolutely black. Clear glass, and dead blacks, are a sign of under exposure and over development, and give hard unartistic pictures. These remarks refer exclusively to photographs from nature, in copying prints, where half tone is produced not by varying intensity in the depth of color, but by the more or less close juxtaposition of black and white lines of different thicknesses, those lines should of course be really black and white. The above directions apply to the production of negatives only. To produce positives, the exposure in the camera should be much shorter than for negatives, the developer No. 4, or 5 should be poured on the plate, and almost immediately washed off again, and the fixing solution poured on. Very little of a positive is seen until it is fixed; its development must almost be taken for granted. The plate is washed and dried the same as a negative.

7.—VARNISHING THE NEGATIVE.

The only really effective varnish that I have yet found, is that known as Sœhnée varnish of the best quality, almost all others that I have tried have a tendency to become sticky when the negative is printed in the sun. The negative being perfectly dry, hold it to a fire till it is just perceptibly warm to the hand, pour the varnish on to it precisely in the same manner as it was coated with collodion, the excess of varnish being poured off into the bottle, hold the plate to the fire till it is perfectly set, and allow it to cool gradually. Never heat a plate more than just sufficiently to prevent the varnish from chilling, and becoming opaque. When a negative is properly varnished, it is difficult without close examination to see which is the varnished side, its surface is so perfectly glassy. Positives will seldom bear varnishing, the deposit is so thin that the varnish runs through it, and gives it a speckled appearance. They are best mounted by placing behind them a plate of glass covered on the back with black varnish.

PRINTING.

PAPER.

Paper for photographic purposes should be of very uniform texture, and with a smooth and somewhat hard surface which does not become woolly on being wetted. It should also be as pure and free from chemicals as possible, and is best sized with starch. Of those at present to be procured, I prefer the best samples of papier Saxe, but all papers leave much to be desired.

PREPARATION OF THE PAPER.

The preparation of positive paper mainly consists in impregnating it with a soluble chloride, and when dry, floating it on a solution of nitrate of silver, so that the surface may become covered with a chloride of that metal. The color assumed by the chloride of silver, and generally its behaviour in the processes of toning and fixing, are curiously modified by the nature of the substance with which the chlorine was originally

combined. Thus blacker tones are produced by a paper impregnated with chloride of sodium than by one containing chloride of ammonium; whilst a paper prepared with chloride of barium, gives a decidedly reddish color. But perhaps the most curious difference which they exhibit, is in their power of resisting the action of the hyposulphite of soda employed for fixing; papers prepared with barium, losing hardly any of their color, as compared with those containing only sodium or ammonium. On account of this greater stability, I always prefer a paper prepared at least in part with chloride of barium, mixing it with various proportions of the chlorides of sodium or ammonium, according to the purpose for which it is intended.

If paper have a really smooth, even, and hard surface, the solutions may be applied to it without further preparation, and except where very minute detail is required, pictures on good plain paper are the most pleasing; but it is so difficult to procure paper with all the necessary requisites, that it is now almost universally the custom to cover it with albumen, in which the chlorides are

dissolved instead of in water, which gives it a smooth and glossy surface. The solutions for the salting of positive paper should contain a quantity of the chlorides employed equivalent to 10 grs. of chloride of sodium. For plain paper these should be dissolved in distilled water. When albumen is employed, the salts should be dissolved in as small a quantity of water as possible, added to the whites of fresh eggs, and the whole beaten together till it is converted into a firm froth. After standing for about twelve hours, a clear liquid goes to the bottom, which must be poured off for use. Whether the aqueous or albuminous solution be employed, it is applied in the following manner.

Pour the solution into a flat dish, somewhat larger than the sheet of paper to be prepared, placed perfectly level; it should cover the bottom of the dish to a depth of about a quarter of an inch. Take the sheet of paper by two corners, and place one end face downwards on the solution, let the paper gradually fall on to the liquid almost at right angles to its surface, so as to push out all air bubbles from underneath it. Allow it to

remain floating on the surface of the liquid till it lies perfectly flat, then take it up by the corners which were first put on the solution, and hang it up to dry. American paper-clips hung on a string are the best things for this purpose. When dry, the paper may be kept for any time in a dry place. Amateurs will find it better not to attempt to albuminize their own paper, as it is an operation requiring much practice, and as the albumen soon spoils, it can only be advantageously done where large quantities of paper are prepared at once, so that all the solution may be speedily used up. When the paper is to be used, it is rendered sensitive by being floated, either in the yellow room or by candle light, on one of the following solutions :—

No. 1.

Nitrate of Silver	800 grs.
Distilled Water	10 ozs.
Nitric Acid	10 drops.

No. 2.

Dissolve separately—

Nitrate of Silver	800 grs.
Distilled Water	5 ozs.
Citric Acid	15 grs.
Distilled Water	5 ozs.

Add the former solution gradually to the latter, stirring all the time. Should any precipitate be formed, the solution must be filtered. The paper should float on these solutions for at least five minutes, and then be hung up to dry in the dark. Paper prepared on No. 1 must be used within forty-eight hours, or it will discolor; that prepared on No. 2 will keep a long time if protected from light and air, and gives as far as I can observe, equally good results.

After albumenized paper has been floated on a silver solution, the latter is apt to discolor, in which case it is not fit for further use. It may be decolorized by shaking up with a little kaolin, and filtering. By use the exciting solution gradually becomes weaker, and after a time paper excited on it ceases to give brilliant prints; it should therefore be examined from time to time, and if it is found to contain less than 65 grs. of nitrate of silver to the oz., that salt should be added in such quantity as will again make it up to 80 grs. The examination is best made by means of an instrument called an argentometer. This consists of a graduated tube,

into which a measured quantity of the solution is poured, and a standard solution of salt dropped in as long as any precipitate is produced, the strength of the solution is so arranged that every division on the tube which is filled, indicates 1 gr. of nitrate of silver in each oz. of solution. The little instruments called silver hydrometers which act by indicating the specific gravity of the solution, are really of no use, the quantity of nitrate of ammonium and barium, &c. formed and dissolved in the bath, preventing its specific gravity from being any indication of the amount of silver it contains.

EXPOSING THE PICTURE.

Lay the negative on the glass of the pressure frame varnished side upwards, place on it a sheet of the prepared paper face downwards, cover this with the pad and put in the back of the pressure frame. Now expose the picture to the light. If direct sunlight be used, care should be taken to place the frame in such a position that the sun's rays fall perpendicularly on to its surface. When printing by diffused daylight, the frame is laid on its

back, and the direct light of the sky allowed to fall on it. The extent to which the printing is to be carried, depends partly on the tone required, and partly on the character of the negative itself. As a rule, all pictures should be printed of a somewhat deeper color than they are intended to be ultimately. The progress of the printing may be watched by raising one half of the back board of the pressure frame, and turning back the paper for an instant.

TONING THE PRINT.

When the picture is sufficiently printed, remove it from the pressure frame. Wash it well under a tap holding it by two corners in such a way as to bisect the stream of water, and moving it backwards and forwards so as to wash every part of it, throw it into a dish of water face downwards, and allow it to soak, changing the water frequently, till all the excess of nitrate of silver is removed; this may be known by the water no longer becoming opalescent. Water containing large quantities of lime salts, and carbonic acid, is not good for this purpose. Still worse is water containing

much organic matter, as it forms colored compounds with the nitrate of silver, and discolors the paper. On the other hand if the water contain no chlorides, so that it does not become opalescent, it is better to add to the first dish of water, a few grains of common salt. The use of this is to convert the nitrate of silver into insoluble chloride, if this be not done, the nitrate dissolves in the water, soaks into the bark of the paper, and is very difficult to remove. The print being washed, place it in one of the following toning baths.

No. 1.

Chloride of Gold	1 gr.
Bicarbonate of Soda	10 grs.
Distilled Water	10o zs.

This bath should be made about two hours before it is used, it does not keep well.

No. 2.

Chloride of Gold	15 grs.
Acetate of Soda	7½ drs.
Distilled Water	90 ozs.

This bath should be kept two or three days before use, it keeps well, and may be repeatedly employed.

No. 3.

Dissolve separately—

Chloride of Ammonium	140 grs.
Hyposulphite of Soda	35 grs.
Distilled Water	10 ozs.
Chloride of Gold	9 grs.
Distilled Water	10 ozs.

Pour the latter gradually into the former, stirring all the time. This bath is ready for use in about an hour, and will keep almost any time.

Leave the print in the bath till it is nearly of the desired tone, but let it be always slightly redder than is ultimately desired. Not more than two or three prints should be toned at once, as they lie one on the other, and prevent the regular action of the bath. The prints should be toned by yellow light, but may be taken for an instant into the daylight to judge of their color more perfectly.

FIXING THE PRINT.

When the print is removed from the toning bath, wash it well under a tap, and afterwards in several waters; then immerse it for half an hour in

Hyposulphite of Soda...	4 ozs.
Water	20 ozs.

When the print is fixed, it must be washed till all traces of hyposulphite are removed, as if any remain in the print, it will fade. It is best first to wash it under the tap as before described, then to place it in a large dish of water where it should remain not more than ten minutes, it should then be again washed under the tap, and placed in a fresh dish of water. The water should now be frequently changed, and between each water the print should be washed under the tap to remove all the former water from its surface. The washing should be continued for about twenty-four hours. The prints are then hung up to dry.

MOUNTING THE PRINT.

Glue is the best material for this purpose, that known as piano-forte maker's glue being preferable; it should be made so thick as not to soak much into the paper, and have a very small quantity of brown sugar added to it. A very small quantity is put quite boiling on to the back of the print, and spread as thin as possible with the fingers, the print is then laid on the mounting board, and is so little stretched

that it does not curl on drying. Arrowroot is the only other substance which can with impunity be used for mounting; it should be boiled to a thick paste, and applied in the same way as the glue; it may however be used cold. All kinds of paste or gum should be avoided, as they are apt to turn sour, and cause the prints to fade. In conclusion, I would press on every one the necessity of extreme cleanliness, as without it good pictures cannot be produced. Every thing should be handled as little as possible, more especially glass plates, and printing paper, as the grease from the fingers, however clean they may be, causes stains. Gloves should be used whenever possible, and cloths, buffs, &c., should never be touched without them.

TABLE OF WEIGHTS AND MEASURES.

TROY OR APOTHECARIES' WEIGHT.

With the Signs for each weight.

Pound, lb.		Ounces, ℥.		Drachms, ʒ.		Scruples, ℈.		Grains, gr.
1	=	12	=	96	=	288	=	5760
		1	=	8	=	24	=	480
				1	=	3	=	60
						1	=	20

The Troy Ounce is sometimes divided thus:—

Ounce, ℥.		Pennyweights, dwt.		Grains, gr.
1	=	20	=	480
		1	=	24

Troy Weight is always employed in receipts.
Goods are bought and sold by

AVOIRDUPOIS WEIGHT.

Pound.		Ounces.		Drachms.		Grains.
1	=	16	=	256	=	7000
		1	=	16	=	437.5
				1	=	27.34

Imperial Measure is the standard measure for Liquids recognized by law.

IMPERIAL MEASURE.

With the Signs for each measure.

Gallon, C.		Pints, O.		Fluid Ounces, f℥.		Fluid Drachms, fʒ.		Minims, ♏.
1	=	8	=	160	=	1280	=	76800
		1	=	20	=	160	=	9600
				1	=	8	=	480
						1	=	60

As confusion of ideas is sometimes occasioned by the fact, that 1 foz. of water contains 480 m. while it contains only 437.5 grs., a Table shewing the number of grs. in each division of the Imperial Measure, and also its equivalent in cubic inches, is subjoined.

IMPERIAL MEASURE.

		Grains.		Cubic Inches.
Gallon	=	70000	=	277.27384
Pint	=	8750	=	34.65923
Fluid Ounce	=	437.5	=	1.73296
Fluid Drachm	=	54.7	=	0.21662
Minim	=	0.91	=	0.00361

As French weights are often used by Photographers, I have added the equivalents of the principal French weights.

	Grains.
Gramme	15.432
Decigramme	1.5432
Centigramme	0.15432
Milligramme	0.015432

The Litre contains 15432 grains of water.